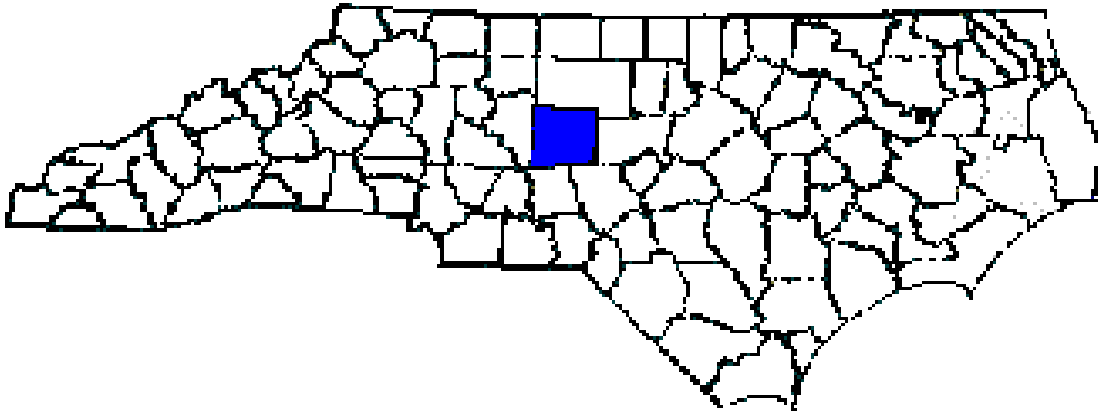
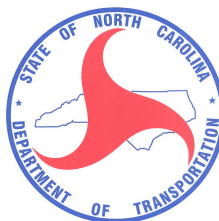


ANNUAL REPORT FOR 2015



UT to Muddy Creek Mitigation Site
Randolph County
TIP No. R-2606WM
COE Action ID: SAW-2004-00340
NCDWR #: 2006-0331



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SUMMARY

The following report summarizes the stream monitoring activities that have occurred during 2015 at the UT to Muddy Creek Mitigation Site in Randolph County. The site was completed construction in November 2010 and planted in March 2011 by the North Carolina Department of Transportation (NCDOT). This report provides the monitoring results for the fifth formal year of monitoring (Year 2015). The Year 2015 monitoring period is the fifth of five scheduled years for monitoring on UT to Muddy Creek Mitigation Site (See Success Criteria Section 2.1).

The longitudinal profile survey was not conducted along the stream at the UT to Muddy Creek Mitigation Site in 2015 due to extensive vegetation growth along the channel. The heavy vegetation growth made it very difficult to complete the longitudinal profile without cutting down many of the desired species along the channel. NCDOT proposed to discontinue profile monitoring at the 2013 Annual Monitoring Meeting and it was agreed that a visual inspection of the channel stability throughout the reach and photo documentation at the permanent photo point locations would be completed. All other monitoring activities will continue to be completed throughout the five year monitoring period.

Based on the overall conclusions of monitoring along the UT to Muddy Creek, the site has met the required monitoring protocols for the fifth formal year of monitoring. Based on comparing the monitoring data to the as-built data, the channel is stable throughout the stream at this time. The streambank and buffer areas are vegetated for the fifth year of monitoring.

NCDOT proposes to discontinue stream monitoring at the UT to Muddy Creek Mitigation Site.

1.0 INTRODUCTION

1.1 Project Description

The following report summarizes the stream monitoring activities that have occurred during 2015 at the UT to Muddy Creek Mitigation Site. The site is located approximately 8 miles southeast of High Point. It is adjacent to US-311 Bypass (R-2606) and just south of Cedar Square Road and north of Spencer Road (Figure 1). The UT to Muddy Creek Mitigation Site was constructed to provide mitigation for stream impacts associated with Transportation Improvement Program (TIP) number R-2606 in Randolph County.

The mitigation project covers approximately 1,380 linear feet of stream restoration. Construction was completed in November 2010 and planted in March 2011 by NCDOT. Stream restoration involved the installation of rock cross vanes, rock a-vanes and rock vanes, construction of a new stream channel and construction of the floodplain to allow for overbank flooding. It also included the installation of coir fiber matting and live stakes along the streambank and bareroot seedlings in the buffer area.

1.2 Purpose

In order for a mitigation site to be considered successful, the site must meet the success criteria. This report details the monitoring in 2015 at the UT to Muddy Creek Mitigation Site. Hydrologic monitoring was not required for the site.

1.3 Project History

November 2010	Construction Completed
March 2011	Planted Live Stakes and Bareroot Seedlings
July 2011	Vegetation Monitoring (Year 1)
October 2011	Stream Monitoring (Year 1)
September 2012	Vegetation Monitoring (Year 2)
October 2012	Stream Monitoring (Year 2)
August 2013	Vegetation Monitoring (Year 3)
December 2013	Stream Monitoring (Year 3)
April 2014	Onsite Regulatory Agency Meeting
May 2014	Herbicide Application on Japanese Honeysuckle
August 2014	Stream and Vegetation Monitoring (Year 4)
July 2015	Stream and Vegetation Monitoring (Year 5)

1.4 Debit Ledger

The entire UT to Muddy Creek stream mitigation site was used for the R-2606 project to compensate for unavoidable stream impacts.



Figure 1. Vicinity Map

2.0 STREAM ASSESSMENT

2.1 Success Criteria

In accordance with the approved mitigation plan, NCDOT will evaluate the success of the stream restoration project based on guidance provided by the Stream Mitigation Guidelines disseminated by the United States Army Corps of Engineers-Wilmington District. The survey of channel dimension will consist of permanent cross sections placed at approximately seven cross sections (four riffles and three pools). Annual photographs showing both banks and upstream and downstream views will be taken from permanent, mapped photo points. The survey of the longitudinal profile will represent distinct areas of the stream and will cover a cumulative total of 1,370 linear feet of channel (Main Channel: 1,275 lf. and Tributary: 95 lf). The entire restored length of stream will be investigated for channel stability and in-stream structure functionality. Any evidence of channel instability will be identified, mapped and photographed.

Vegetation Success

The success of vegetation plantings will be measured through stem counts. Permanent quadrants will be used to sample the riparian buffer. Survival of the live stakes will be determined by visual observation throughout the 5 year monitoring period.

Bareroot vegetation will be evaluated using 4 staked survival plots. Plots will be 50 ft. by 50 ft. and all flagged stems will be counted in those plots. Success will be defined as 320 stems per acre after 5 years. All vegetation monitoring will be conducted during the growing season.

2.2 Stream Description

2.2.1 Post-Construction Conditions

The mitigation project covers approximately 1,380 linear feet of stream restoration. Construction was completed in November 2010 and planted in March 2011 by NCDOT. Stream restoration involved the installation of rock cross vanes, rock a-vane, and rock vanes, construction of a new stream channel and construction of the floodplain to allow for overbank flooding. It also included the installation of coir fiber matting and live stakes along the streambank and bareroot seedlings in the buffer area.

2.2.2 Monitoring Conditions

The objective of the UT to Muddy Creek Mitigation Site was to restore a C5 stream type as identified in the Rosgen's Applied River Morphology. A total of seven cross sections (four in a riffle, three in a pool) were surveyed. For this report, Table 1 only included cross sections containing riffles in the comparison of channel morphology.

Table 1. Abbreviated Morphological Summary (UT to Muddy Creek Cross Sections #1, #3, #4, & #6)						
Variable	As-Built	Cross Section #1 (Riffle) Main Channel	Cross Section #3 (Riffle) Main Channel	Cross Section #4 (Riffle) Tributary	Cross Section #6 (Riffle) Main Channel	Min. - Max Values (Riffle Sections Only)
		2015	2015	2015	2015	2015
Drainage Area (sq. mi)	0.4	0.4	0.4	0.4	0.4	0.4
Bankfull Width (ft.)	11.3	12.36	14.46	11.49	13.94	11.49 – 14.46
Bankfull Mean Depth (ft.)	0.7	0.83	0.76	0.31	0.64	0.31 – 0.83
Width/Depth Ratio	16.1	14.89	19.03	37.06	21.78	14.89 – 37.06
Bankfull Cross Sectional Area (ft ²)	8.0	10.21	11.02	3.53	8.95	3.53 – 11.02
Maximum Bankfull Depth (ft.)	1.0	1.74	2	0.85	1.36	0.85 - 2
Floodprone Area (ft.)	24.9 - 30.5	33.59	47	24.86	41.9	24.86 - 47
Entrenchment Ratio	2.2 – 2.7	2.72	3.25	2.16	3.01	2.16 – 3.25

*Drainage Area, Floodprone Width, and Slope are averaged values only.

*Riffle values are used for classification purposes.

2.3 Results of the Stream Assessment

2.3.1 Site Data

The assessment included the survey of seven cross sections of UT to Muddy Creek established by the NCDOT after construction. Seven cross sections were established during the as-built survey. Cross section locations were subsequently based on the stationing of the longitudinal profile and are presented below. The locations of the cross sections are shown in Appendix A.

- ◆ Cross Section #1. UT Muddy Creek, Station 166+00 linear feet, midpoint of riffle
- ◆ Cross Section #2. UT Muddy Creek, Station 297+00 linear feet, midpoint of pool
- ◆ Cross Section #3. UT Muddy Creek, Station 371+00 linear feet, midpoint of riffle
- ◆ Cross Section #4. UT Muddy Creek, Station 19+00 linear feet, midpoint of riffle (tributary)
- ◆ Cross Section #5. UT Muddy Creek, Station 713+00 linear feet, midpoint of pool
- ◆ Cross Section #6. UT Muddy Creek, Station 957+00 linear feet, midpoint of riffle
- ◆ Cross Section #7. UT Muddy Creek, Station 1160+00 linear feet, midpoint of pool

Based on comparisons of the monitoring data to the as-built data, all seven cross sections appear stable with little or no active bank erosion. Graphs of the cross sections are presented in Appendix A. Future survey data will vary depending on actual location of rod placement and alignment; however this information should remain similar in appearance.

The longitudinal profile survey was not conducted along the stream at the UT to Muddy Creek Mitigation Site in 2015 due to extensive vegetation growth along the channel. The heavy vegetation growth made very difficult to survey the channel without cutting down many of the desired species along the channel. NCDOT proposed to discontinue profile monitoring at the 2013 Annual Monitoring Meeting and it was agreed that a visual inspection of the channel stability throughout the reach and photo documentation at the permanent photo point locations would be completed. All other monitoring activities will continue to be completed throughout the five year monitoring period.

A visual inspection of the channel and photos taken from photo points 1 through 7 showed that the channel bed is stable throughout the stream relocation at this time. Bankfull events have been visually noted by wrack lines on 9/13/12 and 8/26/14.

2.4 Results of Stream and Buffer Vegetation

2.4.1 Description of Species

The following live stake species were planted on the streambank:

Cephalanthus occidentalis, Buttonbush

Cornus amomum, Silky Dogwood

The following tree species were planted in the buffer area:

Platanus occidentalis, Sycamore

Quercus lyrata, Overcup Oak

Betula Nigra, River Birch

Liriodendron Tulipifera, Tulip Poplar

2.4.2 Results of Vegetation Monitoring

Table 2. Vegetation Monitoring Results: Four 50 ft. x 50 ft. vegetation plots were set to determine the trees per acre in the buffer area.

Plot #	Sycamore	Overcup Oak	River Birch	Tulip Poplar	Total (Year 5)	Total (at planting)	Density (Trees/Acre)
1	21	6	2	5	34	38	608
2	12	2	7		21	21	680
3	18	6	6	4	34	42	550
4	14	5	7	4	30	44	464
Year 5 Average Density (Trees/Acre)							576
Year 4 average Density							584
Year 3 Average Density							612
Year 2 Average Density							608
Year 1 Average Density							627

Site Notes: The buttonbush and silky dogwood live stakes are surviving along the streambank. Other vegetation noted included, horse-nettle, sweetgum, *Scirpus* sp., ragweed, Bradford pear, pine, volunteer sycamore, lespedeza, jewelweed, fennel, briars, goldenrod, *Juncus* sp., tear-thumb, baccharis, black willow, pokeberry, cattail, sumac, winged elm, woolgrass, and various grasses. NCDOT sprayed Japanese honeysuckle on May 2, 2014 as requested by the regulatory agencies during the onsite meeting on April 2, 2014. The Japanese honeysuckle noted onsite is not affecting the overall survival of the planted trees in 2015. No further herbicide applications are warranted at this time.

2.4.3 Conclusions

There were four vegetation monitoring plots established throughout the buffer area. The 2015 vegetation monitoring of the site revealed an average tree density of 576 trees per acre. This average is well above the minimum success criteria of 320 trees per acre after year five monitoring.

3.0 OVERALL CONCLUSIONS/RECOMMENDATIONS

The UT to Muddy Creek Mitigation Site has met the required monitoring protocols for the fifth formal year of monitoring. The channel and structures throughout the stream are stable at this time. The streambank and buffer area are vegetated for the fifth year of monitoring.

NCDOT proposes to discontinue stream and vegetation monitoring at the UT to Muddy Creek Mitigation Site.

4.0 REFERENCES

Stream and Wetland Mitigation Plan for UT to Muddy Creek (CF-16 Site) Randolph County, NC, August 2006

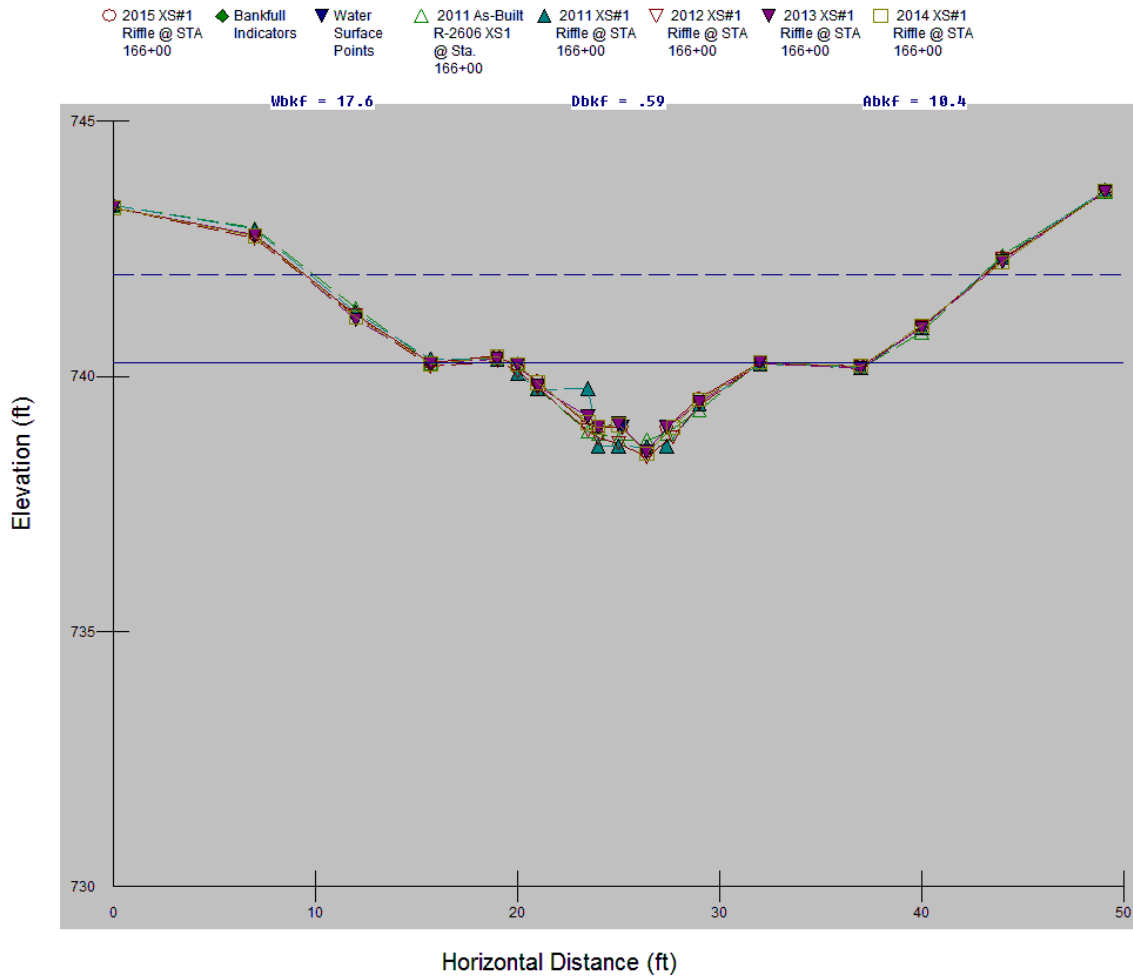
Rosgen, D.L, 1996. Applied River Morphology. Wildland Hydrology, Pagosa Springs, Colorado.

US Army Corps of Engineers (USACE), 2003. Stream Mitigation Guidelines. Prepared with cooperation from the US Environmental Protection Agency, NC Wildlife Resources Commission, and the NC Division of Water Quality.

APPENDIX A

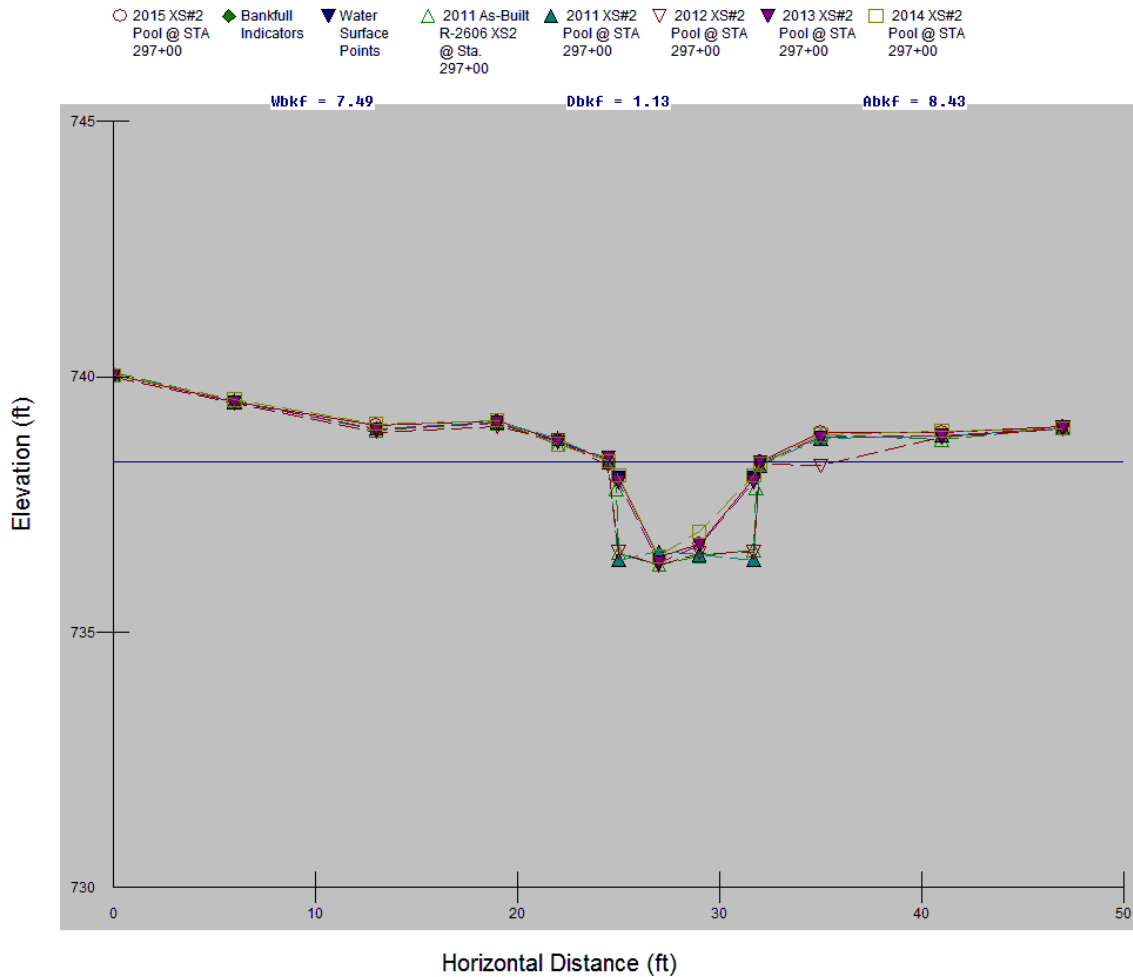
CROSS SECTION COMPARISONS

R-2606 XS#1 @ STA 166+00



Cross-Section #1 (Riffle) Abbreviated Morphological Summary					
	2011	2012	2013	2014	2015
Bankfull Width (ft.)	12.71	12.75	12.3	12.27	12.36
Bankfull Mean Depth (ft.)	0.85	0.94	0.84	0.86	0.83
Width/Depth Ratio	14.95	13.56	14.64	14.27	14.89
Bankfull Cross Sectional Area (ft ²)	10.84	11.93	10.31	10.6	10.21
Maximum Bankfull Depth (ft.)	1.63	1.82	1.75	1.79	1.74
Width of the Floodprone Area (ft.)	32.59	34.21	34.03	34.3	33.59
Entrenchment Ratio	2.56	2.68	2.77	2.8	2.72

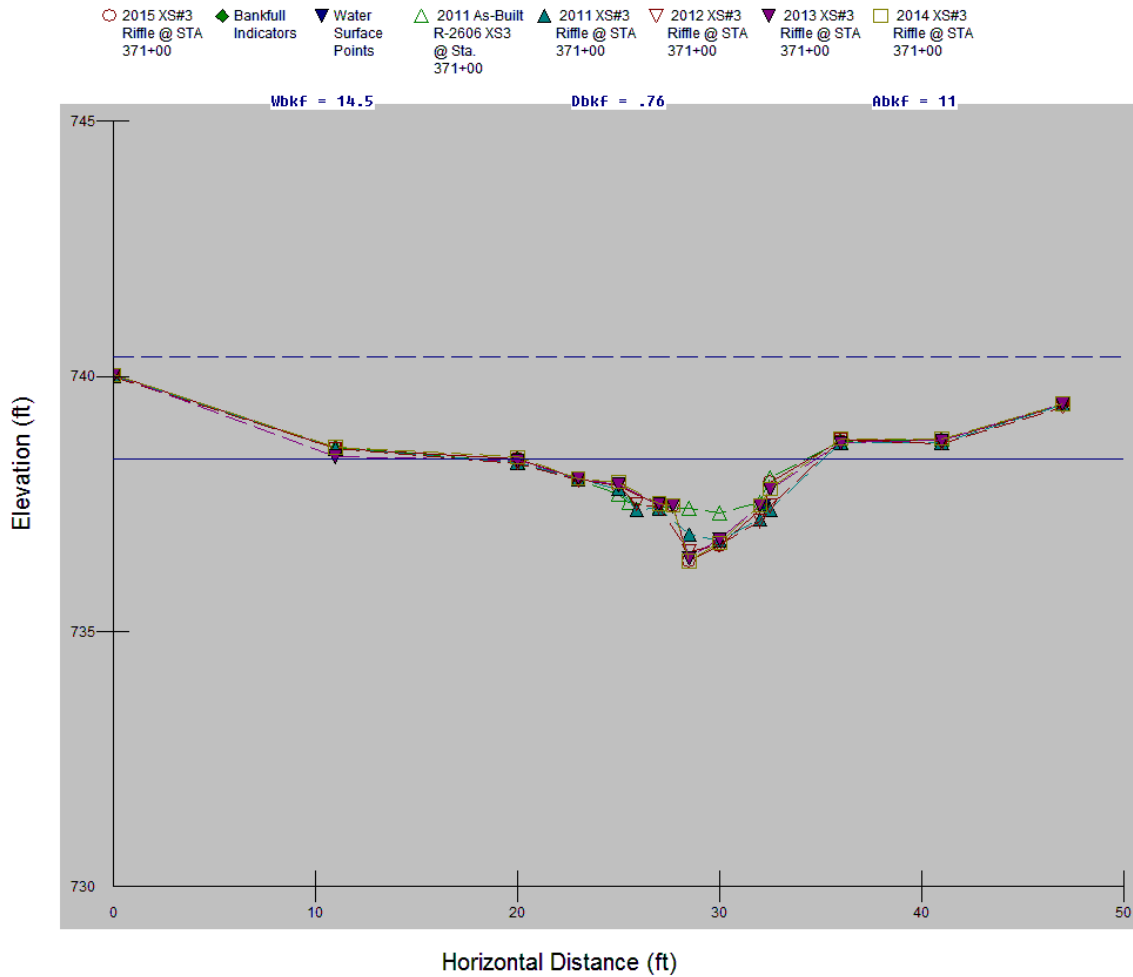
R-2606 XS#2 Pool @ STA 297+00



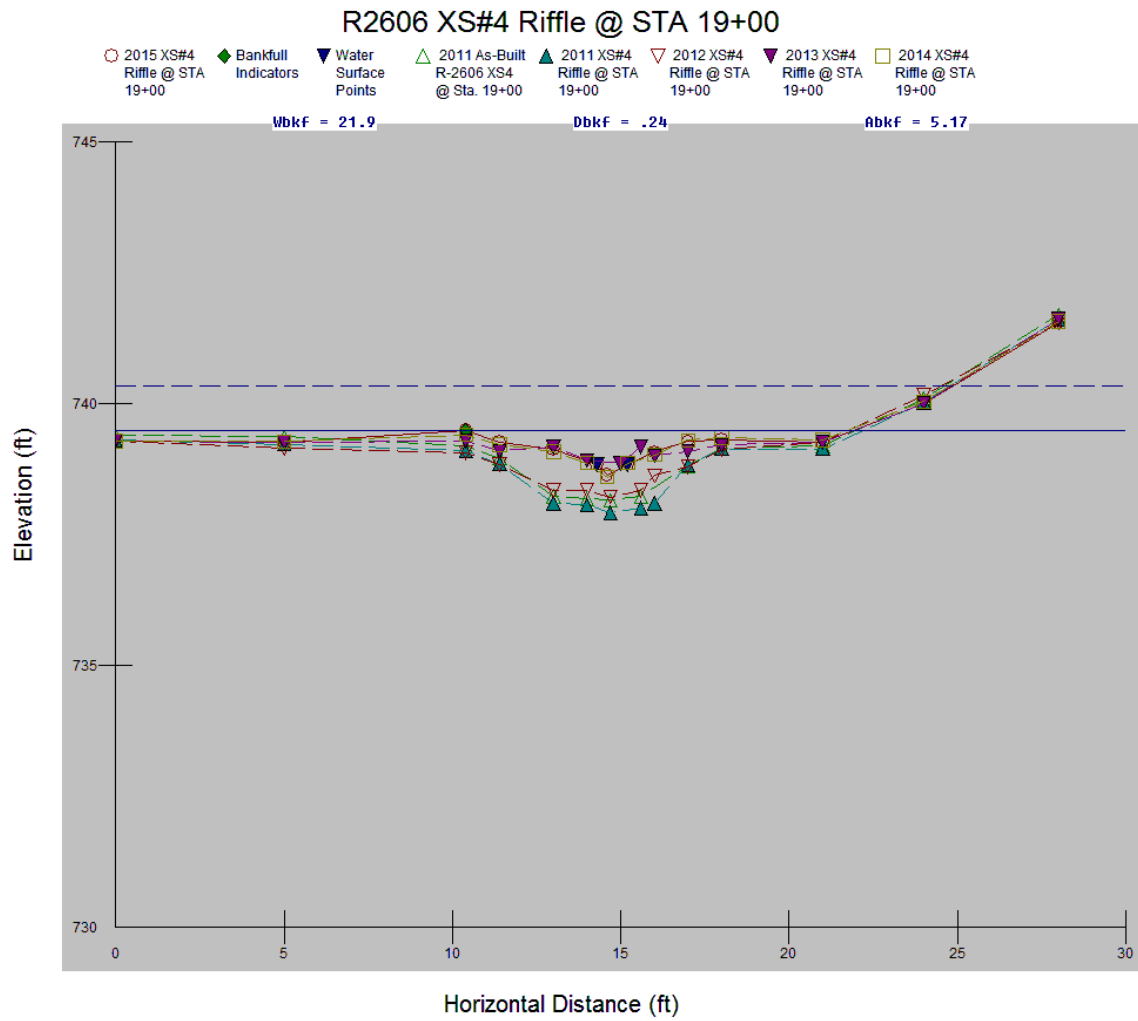
Cross-Section #2 (Pool) Abbreviated Morphological Summary*					
	2011	2012	2013	2014	2015
Bankfull Cross Sectional Area (ft ²)	17.95	12.52	8.66	7.3	8.43
Maximum Bankfull Depth (ft.)	2.39	1.98	1.95	1.8	1.87
Bankfull Mean Depth (ft.)	1.38	1.15	1.17	0.99	1.13
Bankfull Width (ft.)	13	10.93	7.39	7.39	7.49

* According to the Rosgen Classification of Natural Rivers floodprone width, entrenchment ratio, and width depth ratio are not measured in pool, glide, or run features.

R-2606 XS#3 Riffle @ STA 371+00

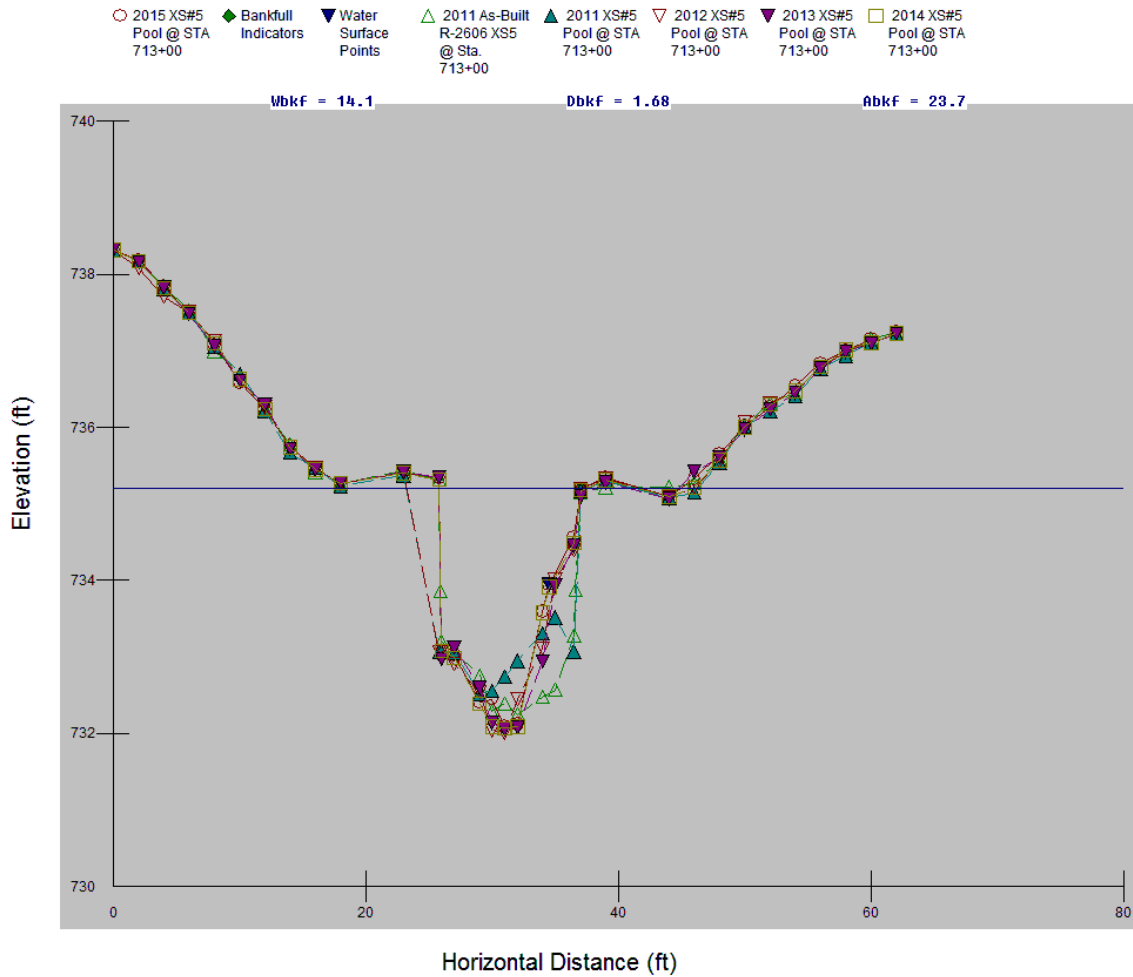


Cross-Section #3 (Riffle) Abbreviated Morphological Summary					
	2011	2012	2013	2014	2015
Bankfull Width (ft.)	14.94	14.76	14.65	14.71	14.46
Bankfull Mean Depth (ft.)	0.75	0.77	0.71	0.77	0.76
Width/Depth Ratio	19.92	19.17	20.63	19.1	19.03
Bankfull Cross Sectional Area (ft ²)	11.18	11.38	10.37	11.29	11.02
Maximum Bankfull Depth (ft.)	1.53	1.73	1.91	2.04	2
Width of the Floodprone Area (ft.)	45.62	47	47	47	47
Entrenchment Ratio	3.05	3.18	3.21	3.19	3.25



Cross-Section #4 (Riffle) Abbreviated Morphological Summary					
	2011	2012	2013	2014	2015
Bankfull Width (ft.)	8.95	7.39	10.68	10.6	11.49
Bankfull Mean Depth (ft.)	0.61	0.47	0.17	0.25	0.31
Width/Depth Ratio	14.67	15.72	62.82	42.4	37.06
Bankfull Cross Sectional Area (ft ²)	5.42	3.48	1.76	2.66	3.53
Maximum Bankfull Depth (ft.)	1.22	0.84	0.43	0.81	0.85
Width of the Floodprone Area (ft.)	24.84	23.11	22.82	24.47	24.86
Entrenchment Ratio	3.05	3.13	2.14	2.31	2.16

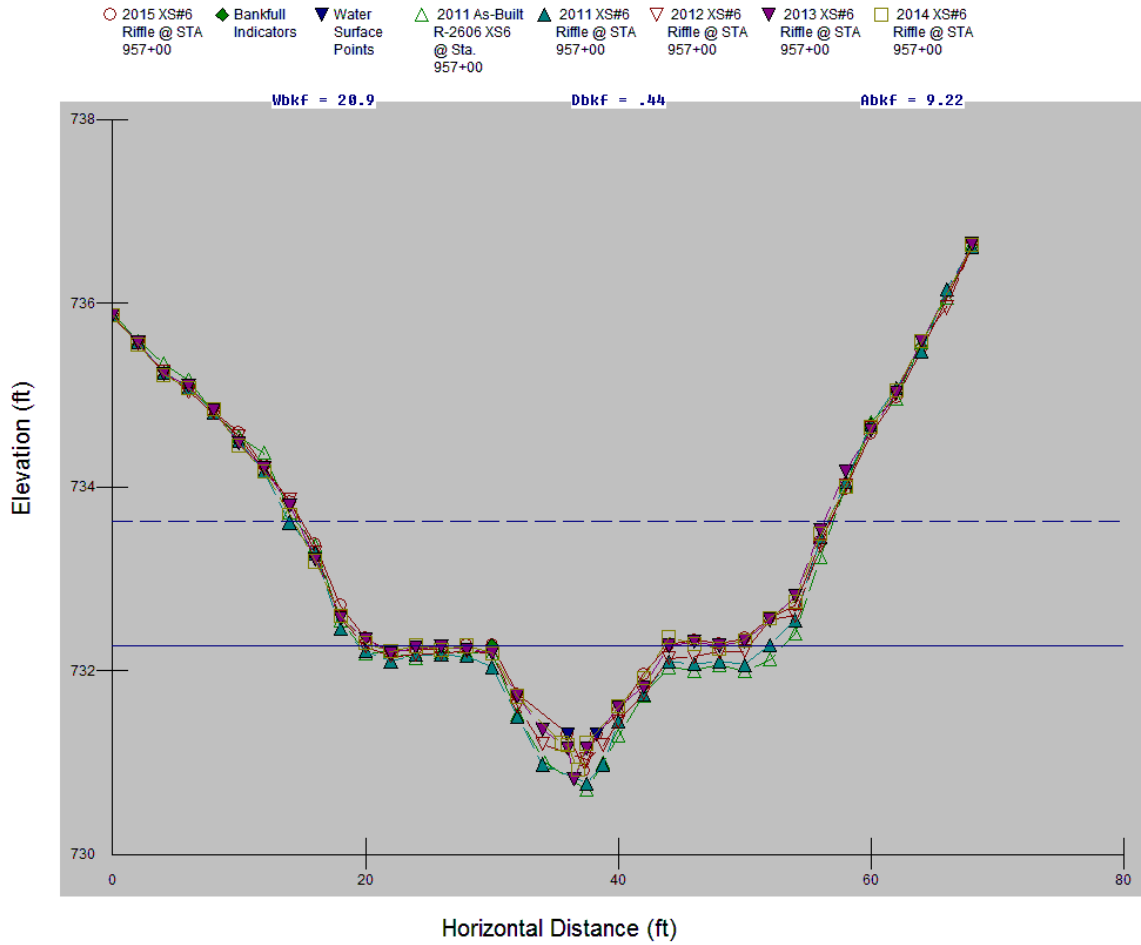
R-2606 XS#5 Pool @ STA 713+00



Cross-Section #5 (Pool) Abbreviated Morphological Summary*					
	2011	2012	2013	2014	2015
Bankfull Cross Sectional Area (ft ²)	26.83	27.78	23.86	24.12	23.72
Maximum Bankfull Depth (ft.)	2.65	3.19	3.04	3.11	3.11
Bankfull Mean Depth (ft.)	1.5	1.55	1.98	1.66	1.68
Bankfull Width (ft.)	17.9	17.87	12.07	14.55	14.14

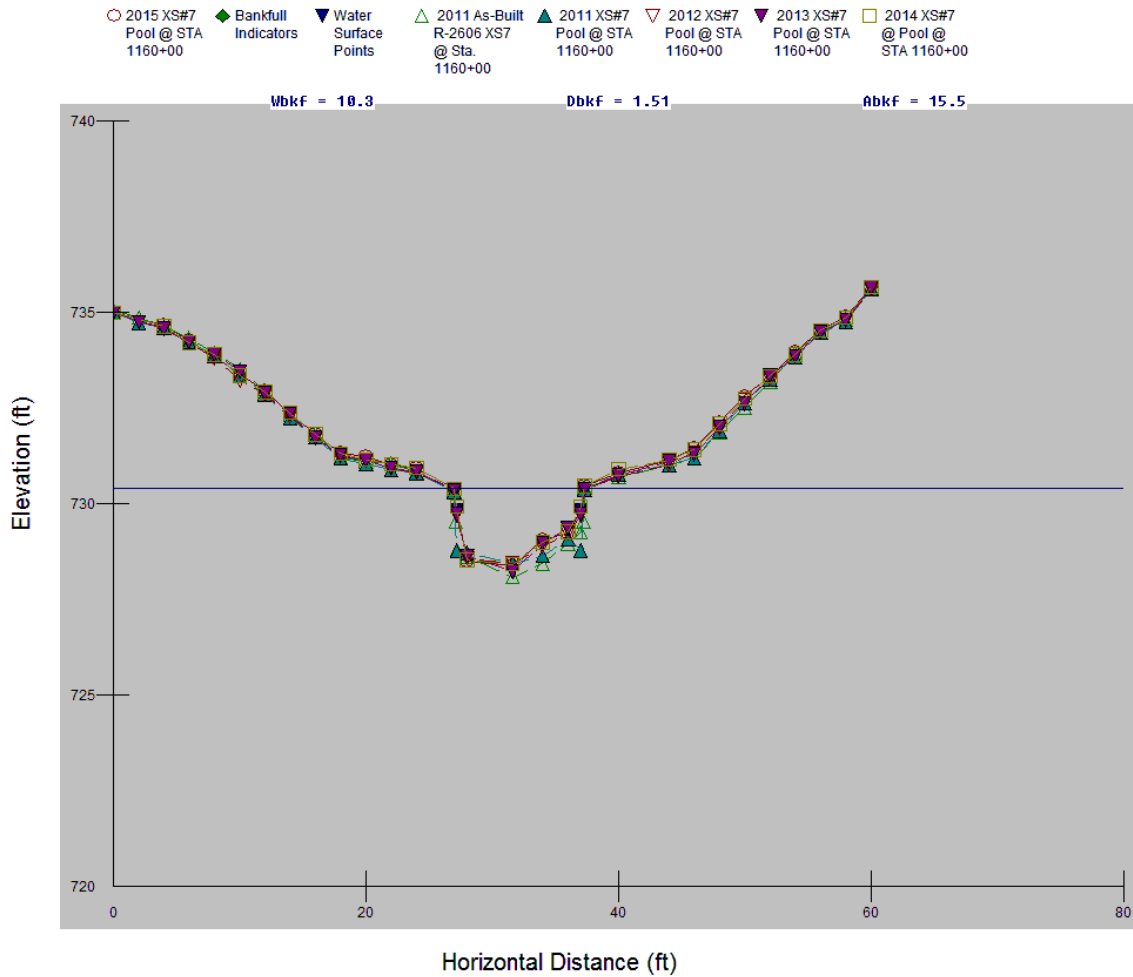
* According to the Rosgen Classification of Natural Rivers floodprone width, entrenchment ratio, and width depth ratio are not measured in pool, glide, or run features.

R-2606 XS#6 Riffle @ STA 957+00



Cross-Section #6 (Riffle) Abbreviated Morphological Summary					
	2011	2012	2013	2014	2015
Bankfull Width (ft.)	15	13.79	14	13.23	13.94
Bankfull Mean Depth (ft.)	0.71	0.67	0.7	0.62	0.64
Width/Depth Ratio	21.13	20.58	20	21.34	21.78
Bankfull Cross Sectional Area (ft ²)	10.72	9.21	9.85	8.16	8.95
Maximum Bankfull Depth (ft.)	1.33	1.1	1.45	1.27	1.36
Width of the Floodprone Area (ft.)	40.86	39.49	42.32	40.98	41.9
Entrenchment Ratio	2.72	2.86	3.02	3.1	3.01

R-2606 XS#7 Pool @ STA 1160+00



Cross-Section #7(Pool) Abbreviated Morphological Summary*					
	2011	2012	2013	2014	2015
Bankfull Cross Sectional Area (ft ²)	16.32	15.44	15.55	15.33	15.5
Maximum Bankfull Depth (ft.)	1.85	1.92	2.14	1.97	2.01
Bankfull Mean Depth (ft.)	1.59	1.5	1.51	1.49	1.51
Bankfull Width (ft.)	10.3	10.3	10.29	10.26	10.27

* According to the Rosgen Classification of Natural Rivers floodprone width, entrenchment ratio, and width depth ratio are not measured in pool, glide, or run features

APPENDIX B

SITE PHOTOGRAPHS, CROSS SECTION, VEGETATION

PLOT & PHOTO POINT LOCATIONS

UT to Muddy Creek



Photo Point #1 (Upstream)



Photo Point #1 (Downstream)



Photo Point #2 (Upstream)



Photo Point #2 (Downstream)



Photo Point #3 (Upstream)

July 2015



Photo Point #3 (Downstream)

UT to Muddy Creek



Photo Point #4 (Upstream @ Tributary)



Photo Point #4 (Downstream @ Tributary)



Photo Point #5 (Upstream)



Photo Point #5 (Downstream)



Photo Point #6 (Upstream)



Photo Point #6 (Downstream)

July 2015

UT to Muddy Creek



Photo Point #7 (Upstream)



Photo Point #7 (Downstream)



Vegetation Overview



Vegetation Overview



Vegetation Overview
July 2015



Vegetation Overview

